

From Synoptic to Microscale: A Case Study of a Frontal Passage using Multiple OLYMPEX Observations

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University of Washington

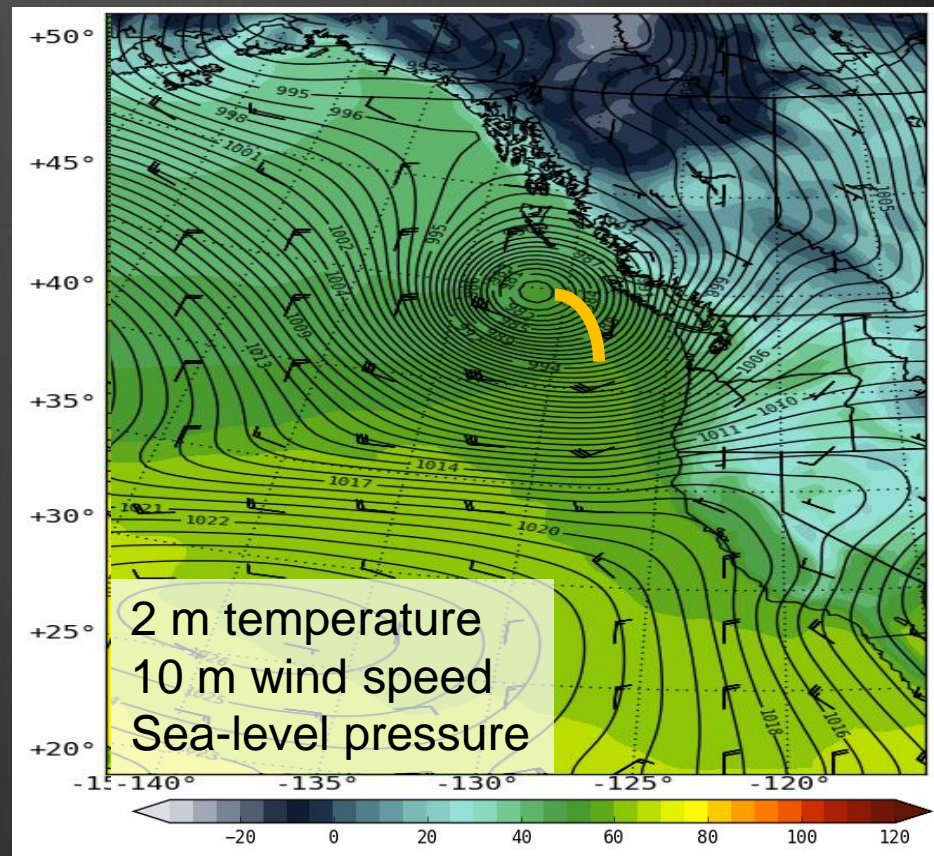
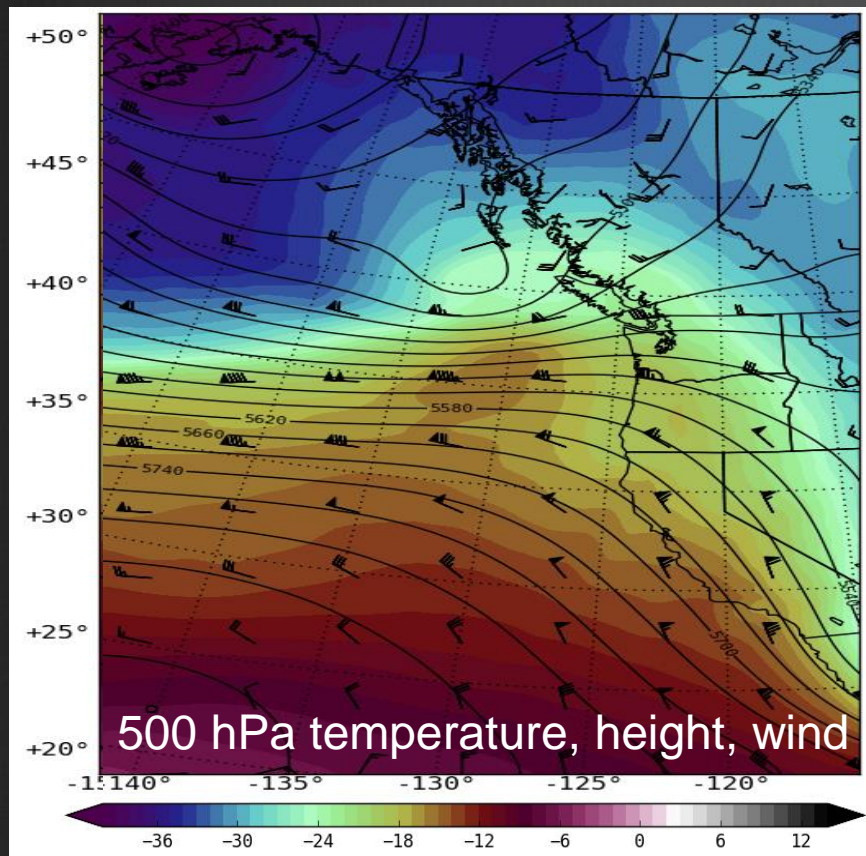
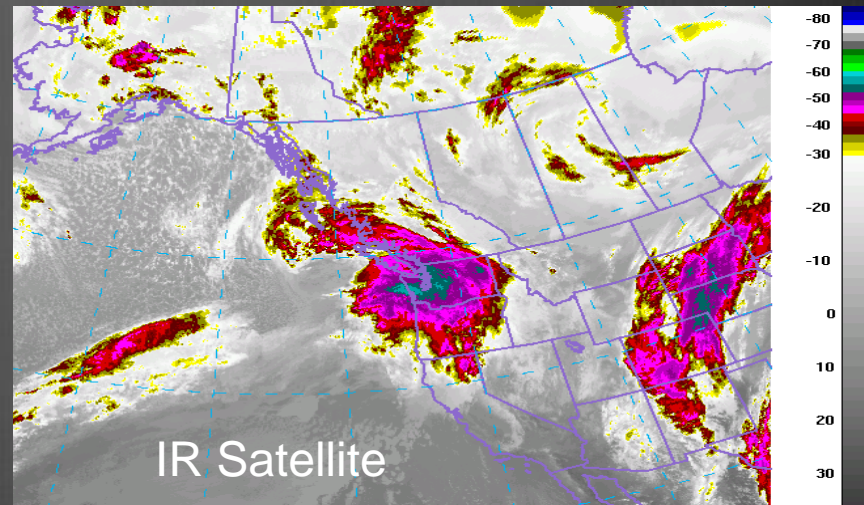
Pacific Northwest Weather Workshop
4th March 2016
NOAA Western Regional Center, Seattle, WA

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Occluded Front

**Synoptic Conditions
1800 UTC 12 December**



***What happened during
the passage of the
occluded front?***



12 December 2015 Timeline

12 13 14 15 16 17 18 19 20 21 UTC

Weather Events

Pre-Frontal

Frontal

Post-Frontal

KHI Waves

DOW Radar

NPOL Radar

D3R Radar

Env. Can. Radar

Quillayute Soundings ●

Env. Can. Soundings

NPOL Soundings ● ● ●

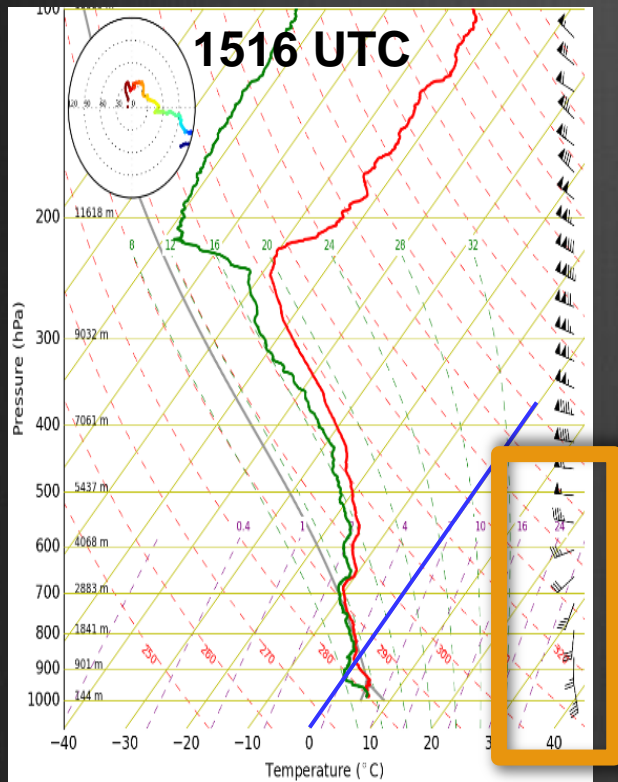
ER-2 Aircraft

DC-8 Aircraft

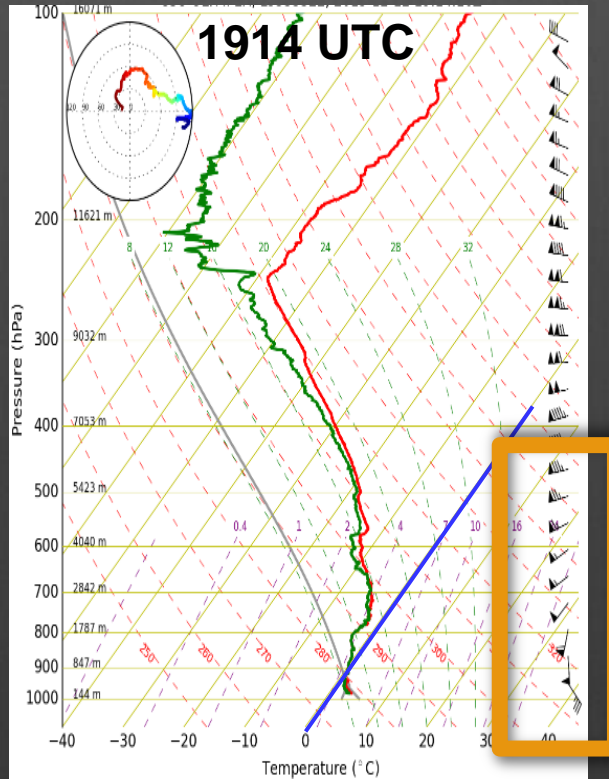
Citation Aircraft

Ground Instruments

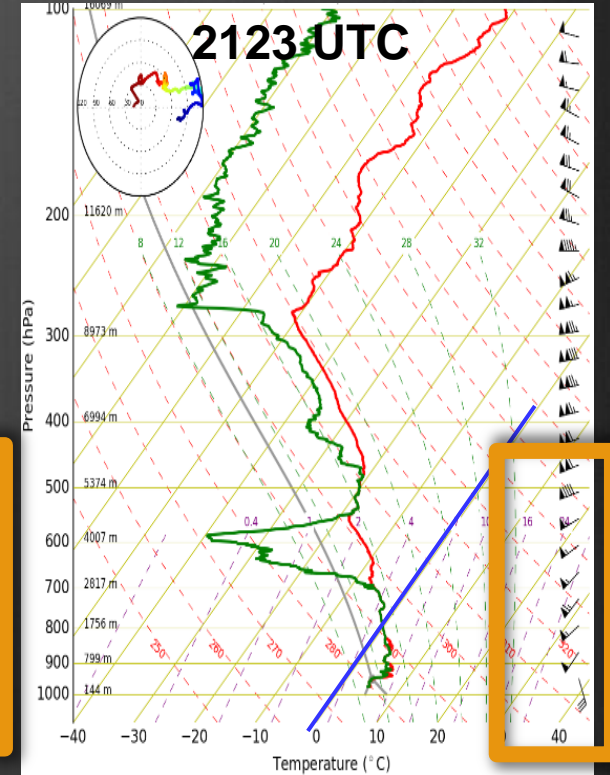
NPOL Soundings 12 December



Pre-Frontal



Frontal

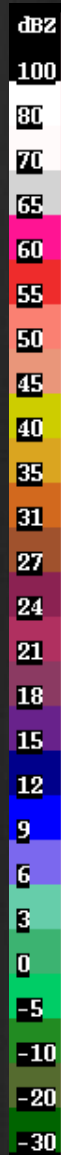
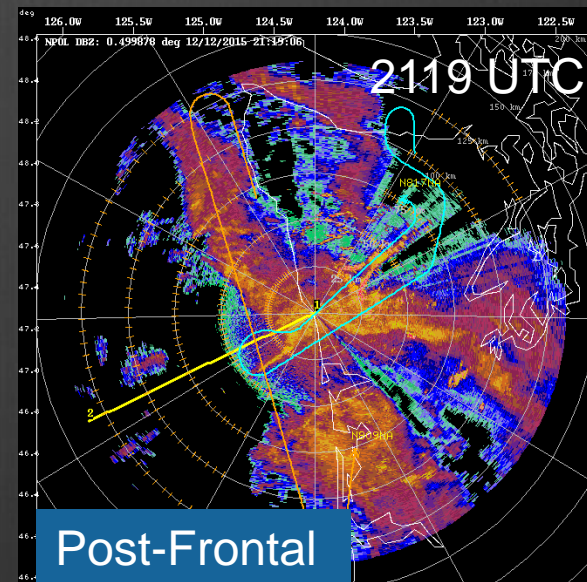
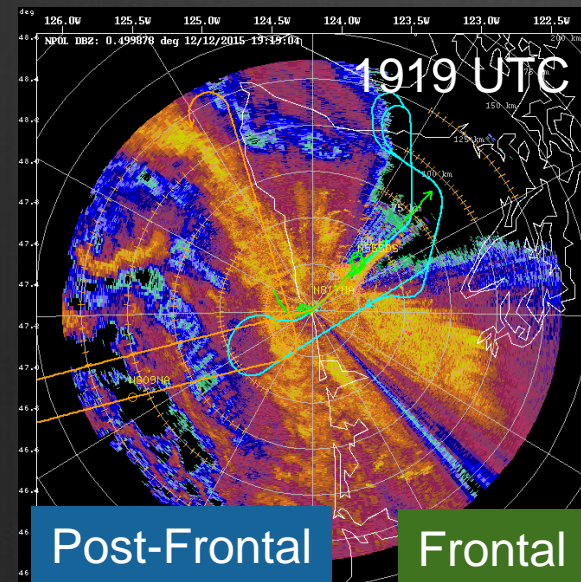
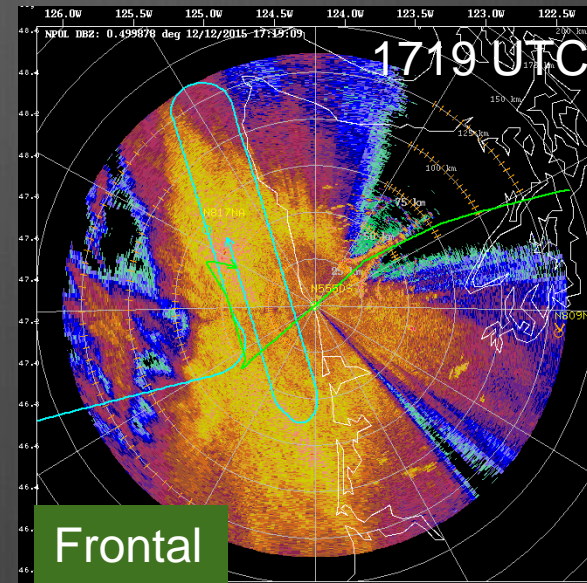
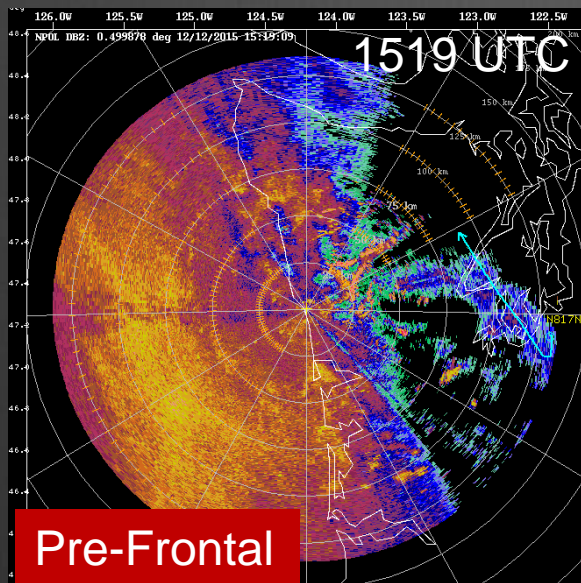


Post-Frontal

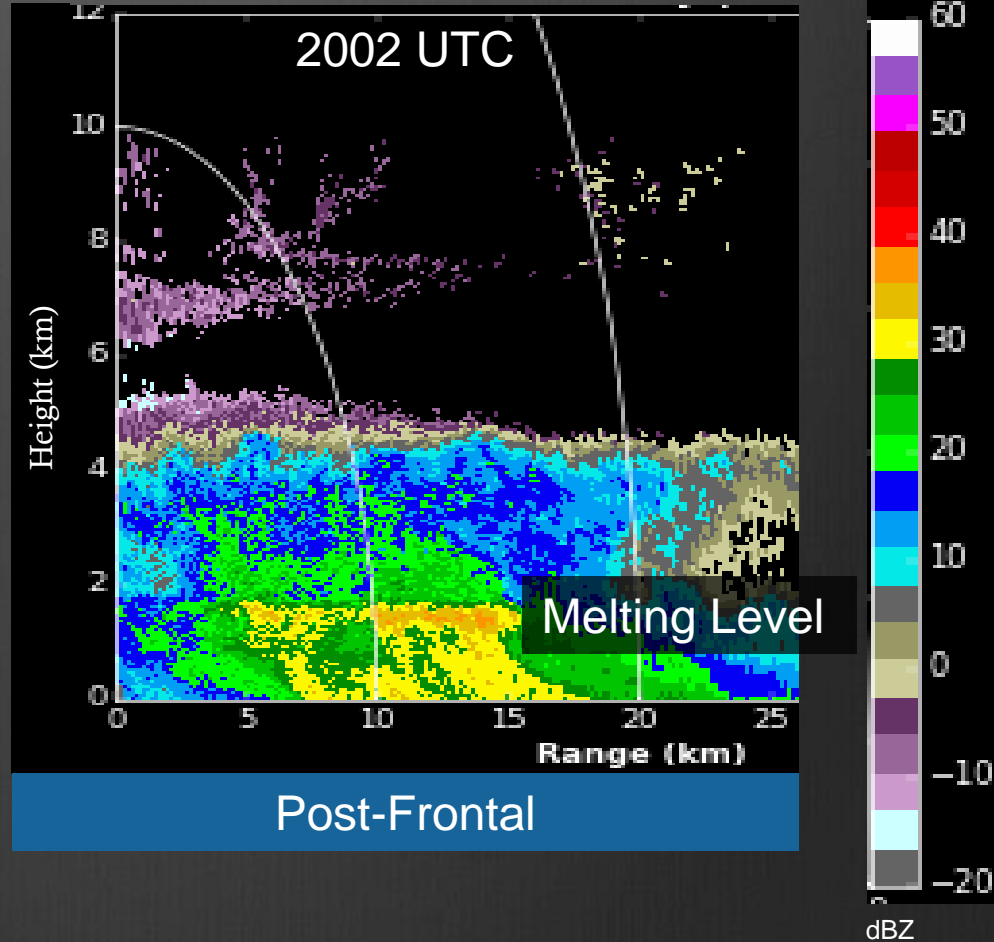
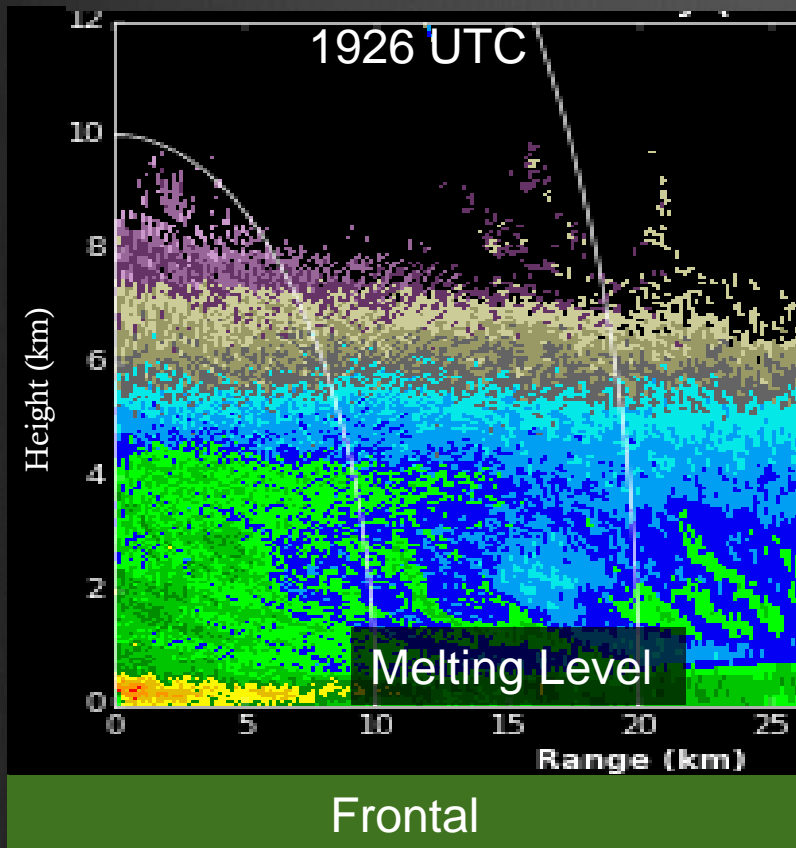
- Increase winds

- Melting level rise

NPOL Reflectivity and Flight Tracks



D3R Radar Ku-Band Reflectivity

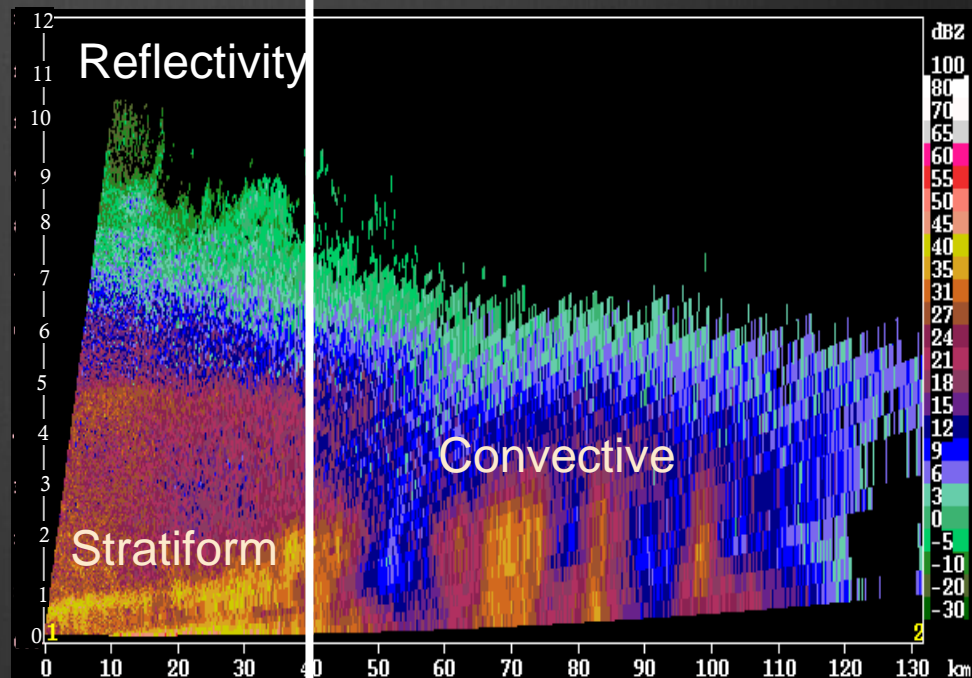
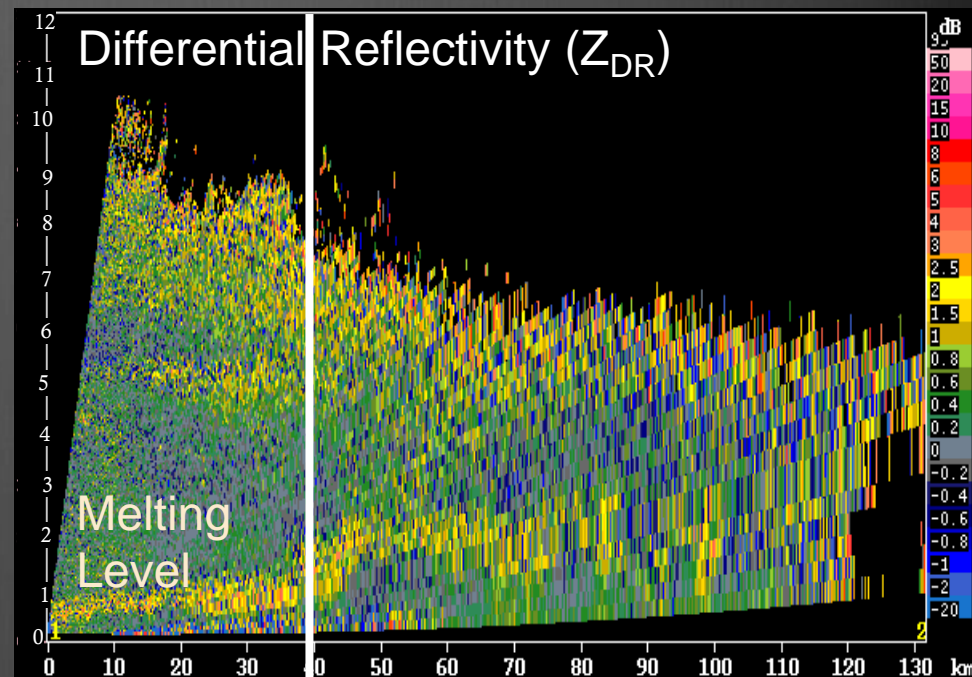


Melting level rose rapidly.

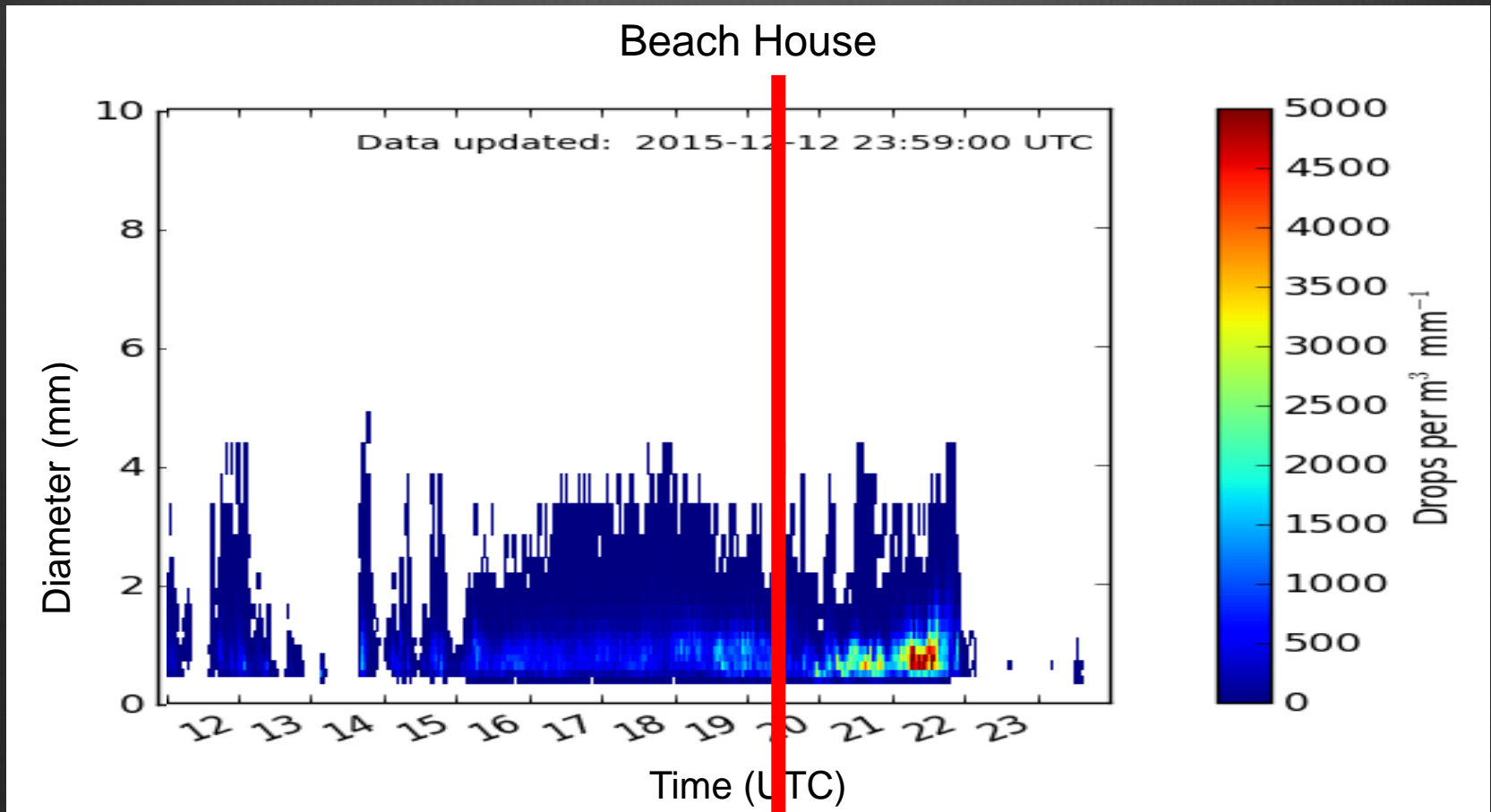
NPOL S-Band Radar

1842 UTC

- Melting level rose abruptly
- Nature of convection changes



Ground Observations: Particle Size Distribution



Pre-Frontal and Frontal

- Stratiform
- Broad distribution

Occluded Front

Post-Frontal

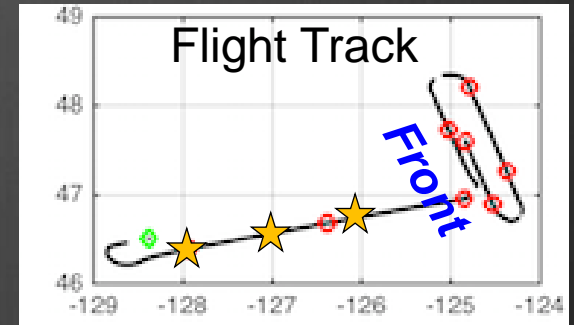
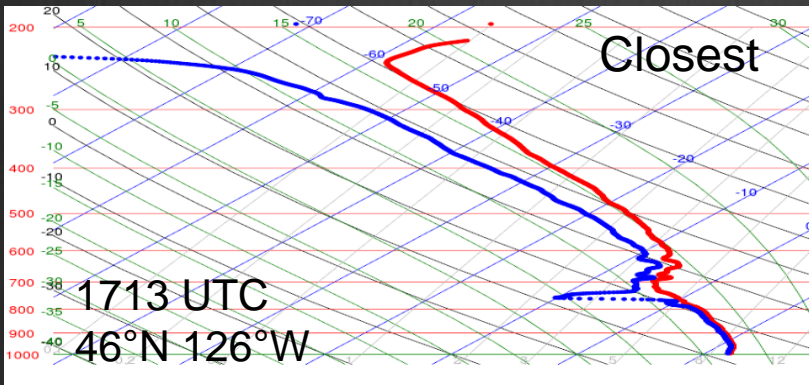
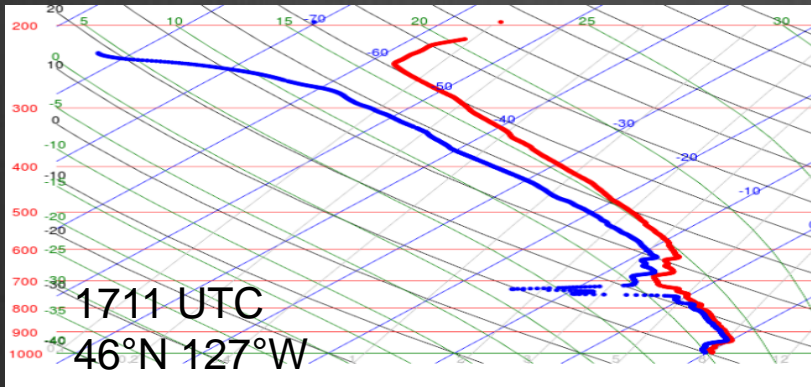
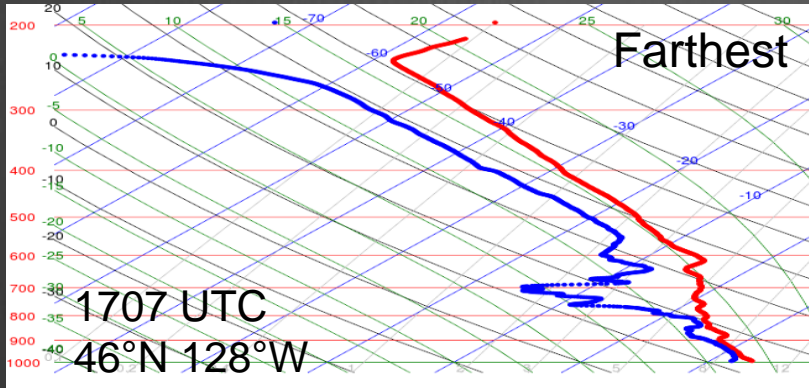
- Convective
- Lots small

Microscale Dynamical Features

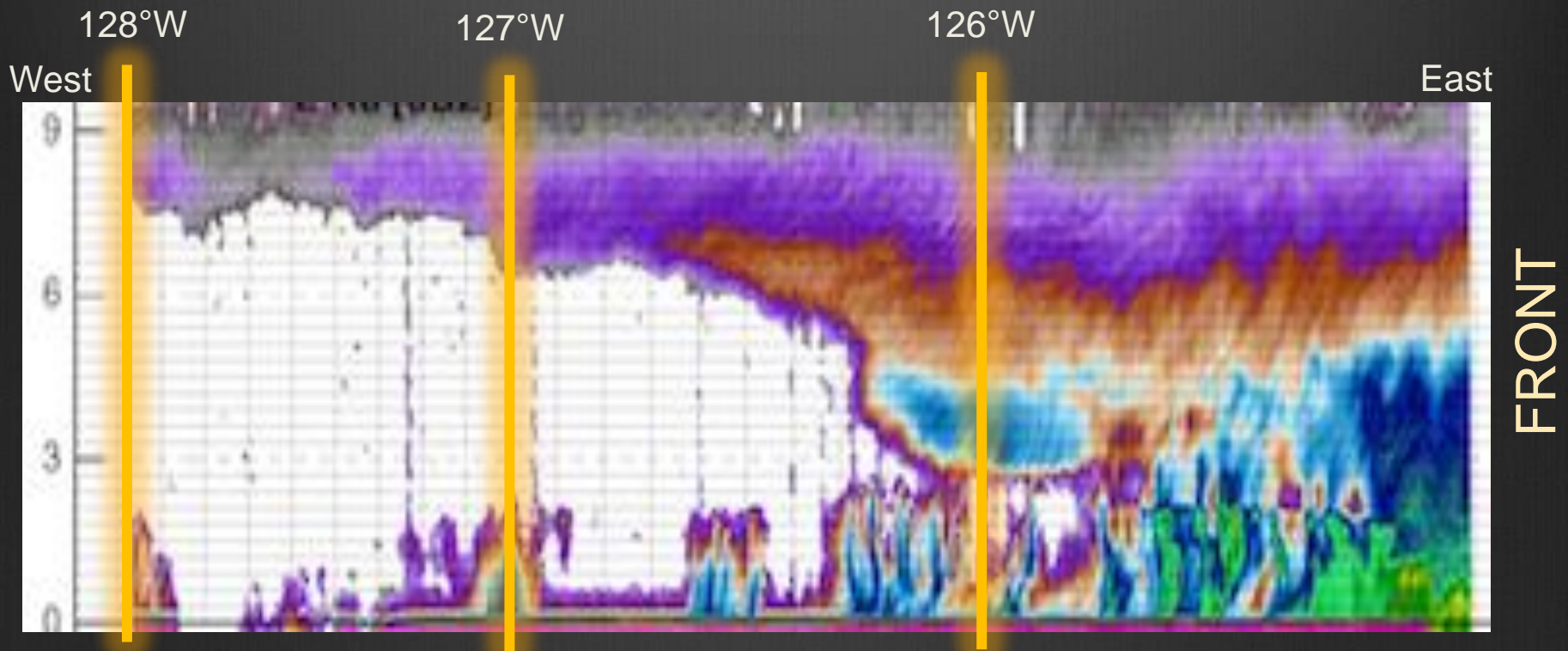
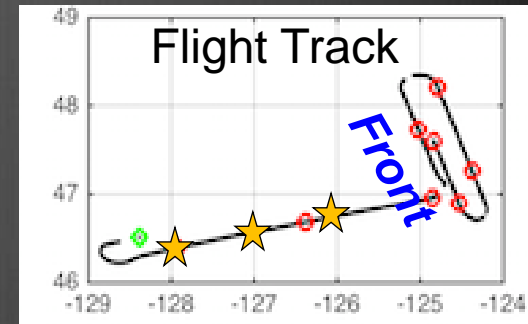


DC8 Aircraft Data - Dropsondes

Dropsondes Toward Front



DC8 Aircraft Data - Ka-Band Reflectivity

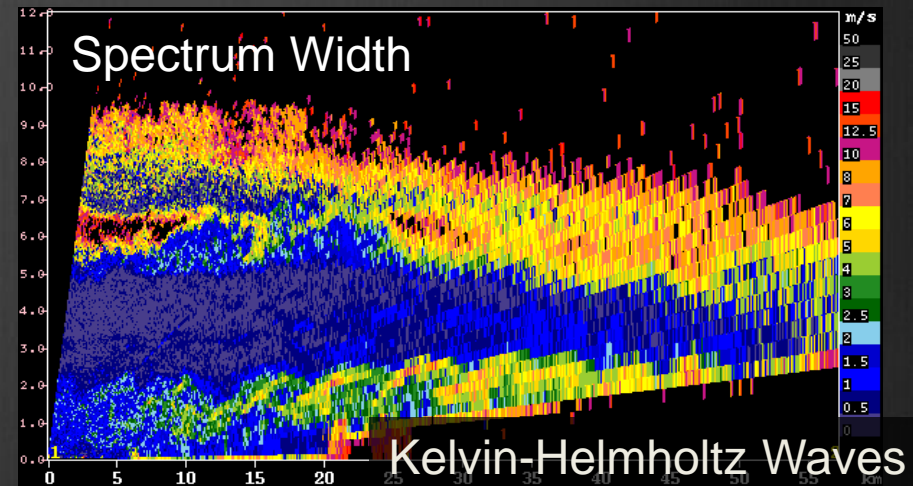
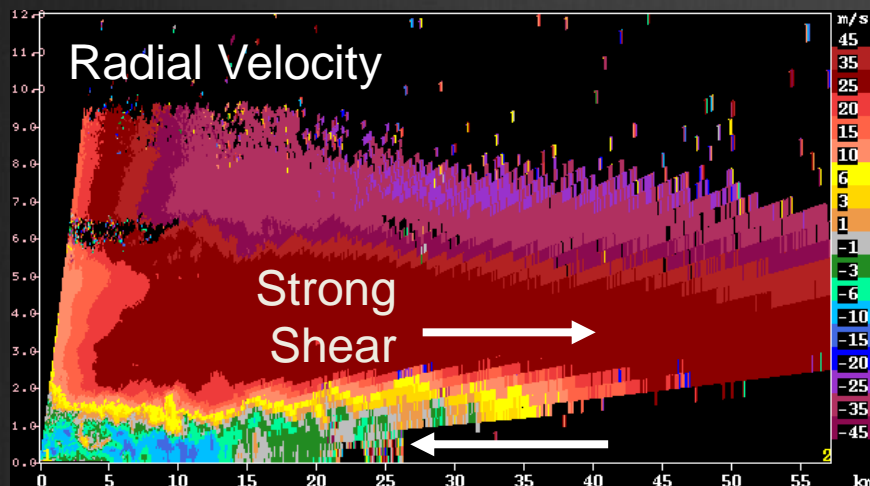
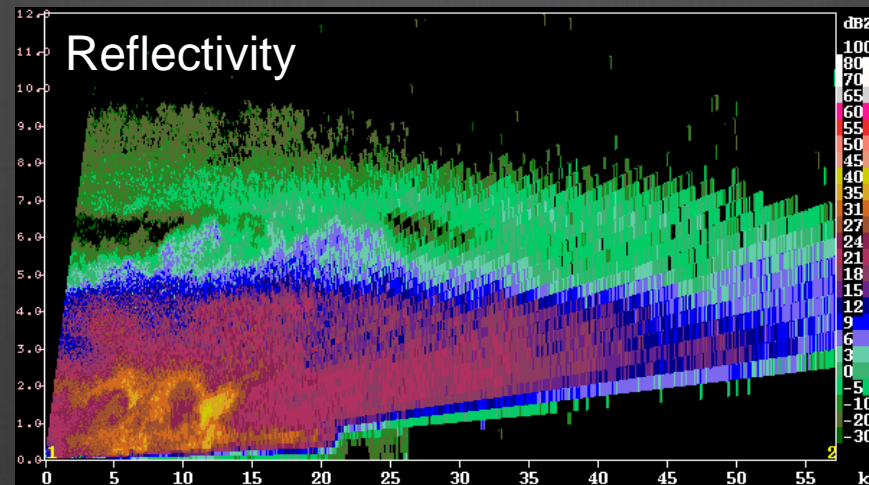


More upper-level clouds and shallow precipitation as approach front.

DOW X-Band Radar

2102 UTC

Shear induced Kelvin-Helmholtz waves

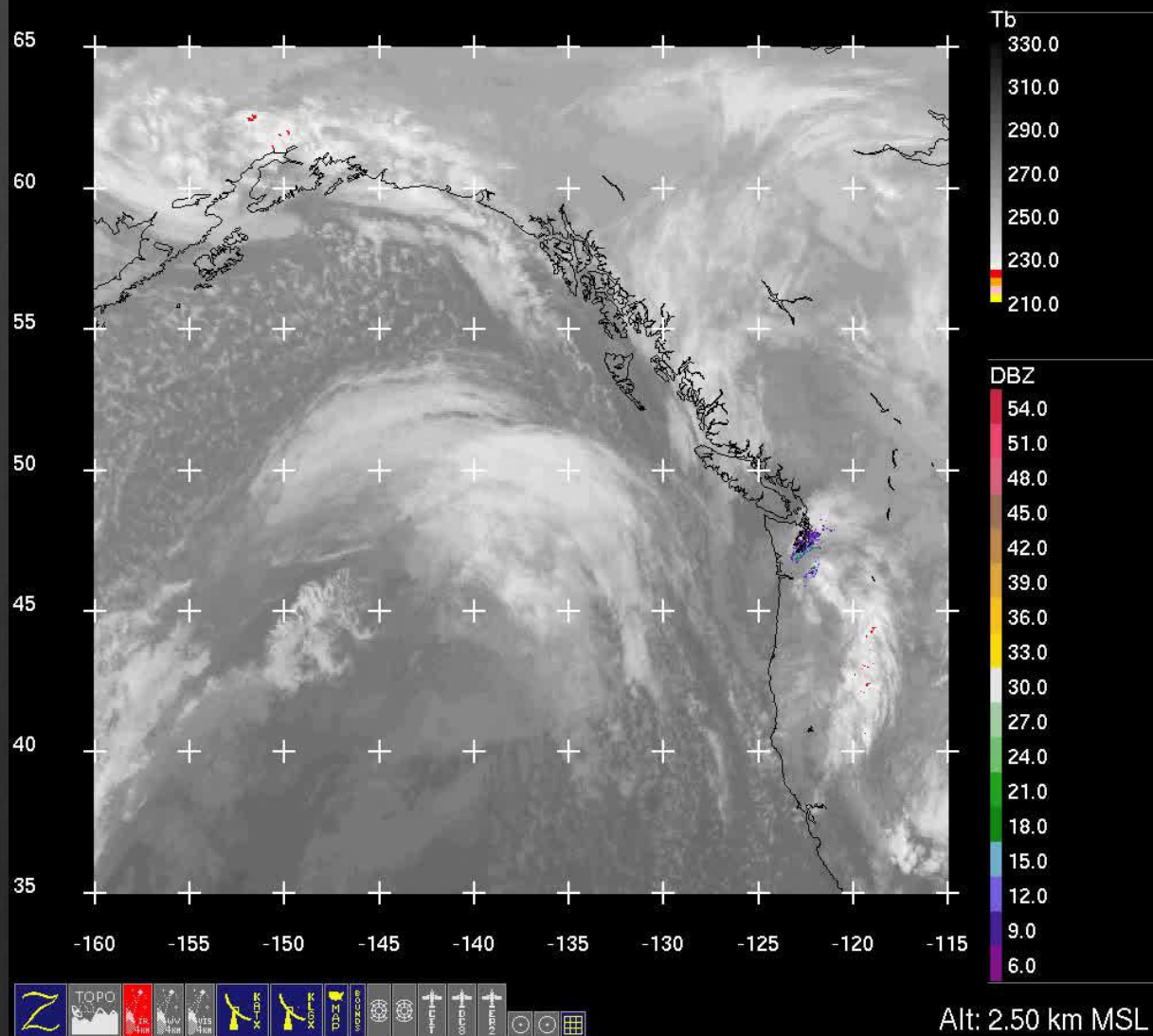


Conclusions

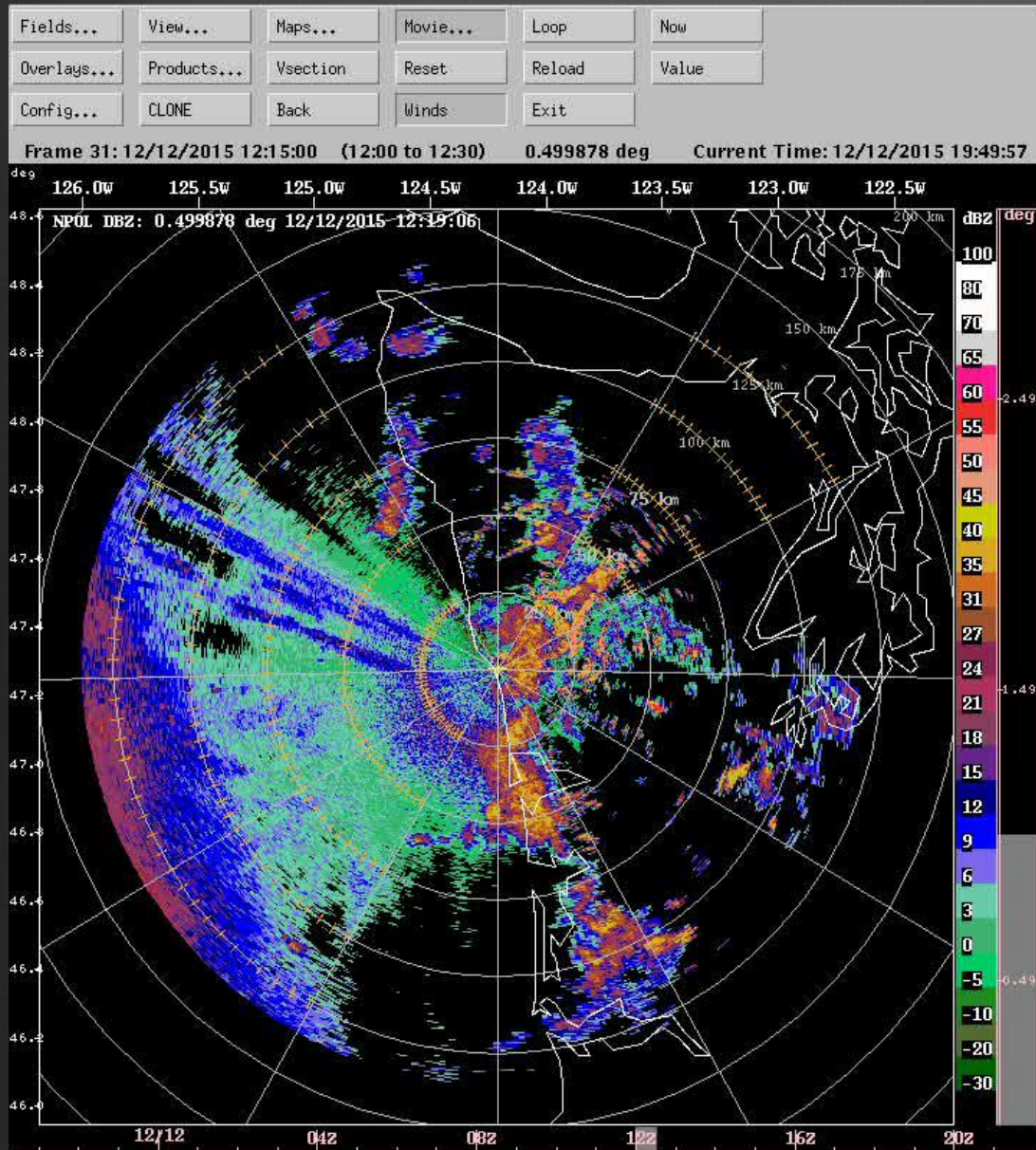
- OLYMPEX observations allow analysis from synoptic to microscale
- 12 December 2015
 - *Synoptic*: Occluded front
 - *Mesoscale*:
 - Abrupt rise in melting level
 - Stratiform -> convective
 - *Microscale*:
 - Drop size changes
 - Midlevel drying behind front
 - Kelvin-Helmholtz waves
- Similar analyses available for all days during OLYMPEX available at [http://olympex.atmos.washington.edu/index.html?x=Science Summaries](http://olympex.atmos.washington.edu/index.html?x=Science_Summaries)

Satellite Loop

12-dec-2015,00:25:00 Zebra projection: goes_ir Tb plot. Katx DBZ filled contour. Klgx DBZ filled contour.

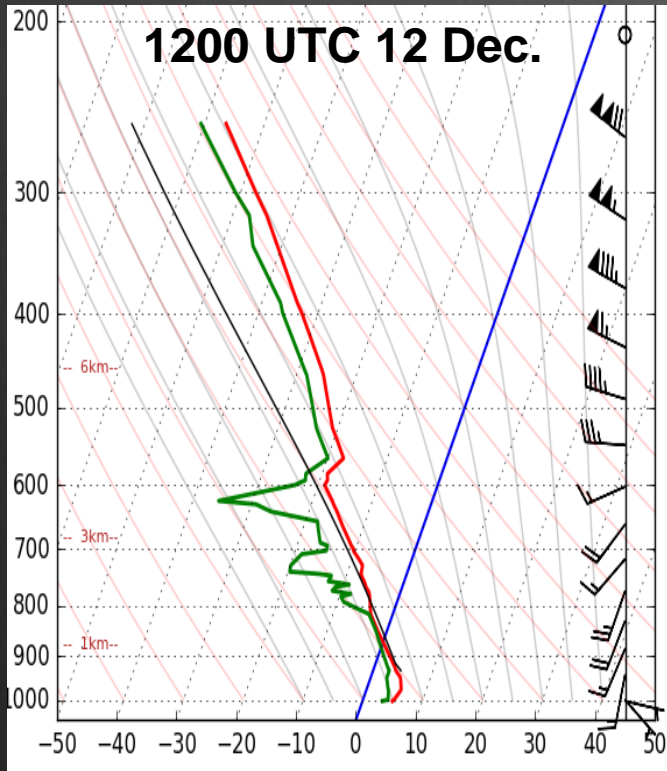


12 December 2015 Occluded Front

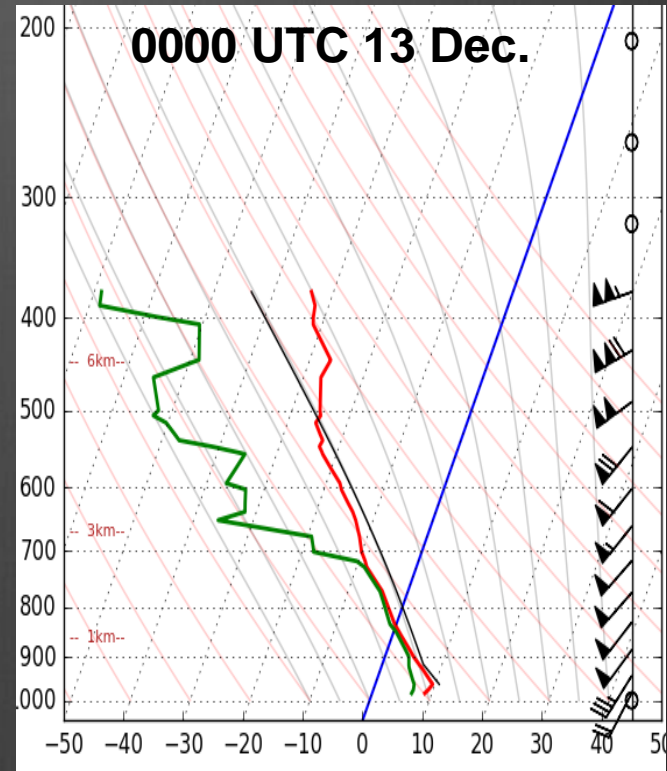


NPOL S-Band Reflectivity

Quillayute Sounding Data



Pre-Frontal

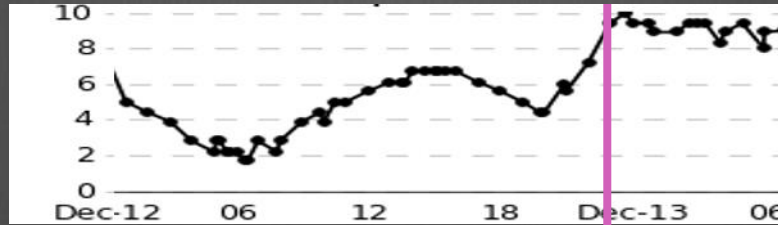


Post-Frontal

- Mid-upper troposphere dries
- Destabilize
- Melting level rise
- Winds increase

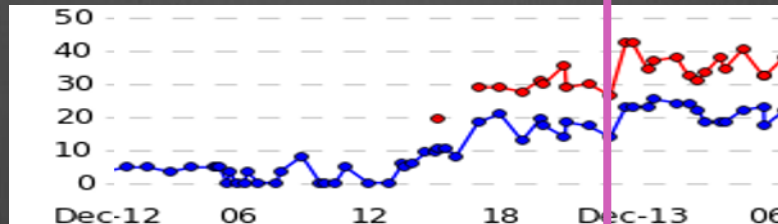
Quillayute Surface Obs. - 12 Dec. 2015

Temperature (°C)

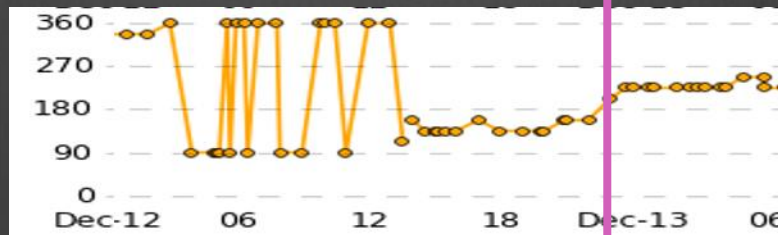


Temperature rise

Average wind speed and gusts (mph)

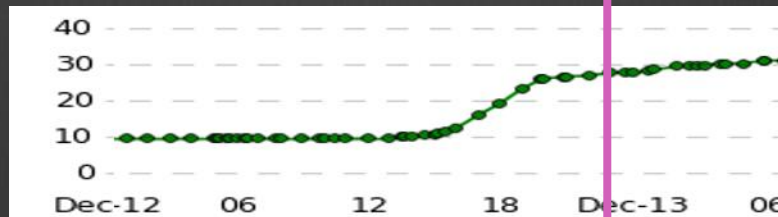


Wind direction



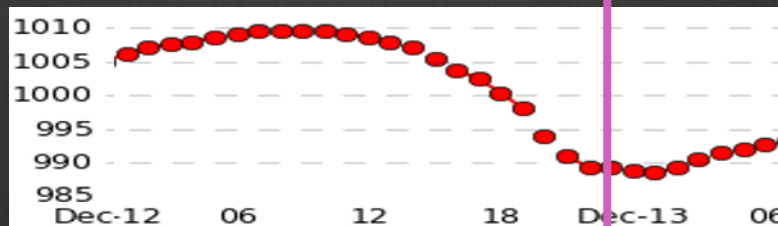
Change in wind direction

Accumulated precipitation (mm)



Most precipitation before front

Mean sea-level pressure (hPa)



Broad pressure trough

Time (UTC)

Occluded Front